

WHAT IS CLAIMED IS:

Sub Q1

1. A writing element for recording data to a hard magnetic recording layer of a rotating disc, the writing element comprising:
 - a writing pole having a pole tip and extending therefrom to a back gap region;
 - a conducting coil having coil segments positioned adjacent and transverse to the writing pole and proximate the pole tip, the coil segments adapted to produce magnetic signals that orient magnetization vectors at the pole tip of the writing pole in a desired direction; and
 - an insulating material between the writing pole and the coil segments;wherein the magnetic signals do not conduct to the back gap region through a return pole element.
2. The writing element of claim 1, wherein the conducting coil wraps around the writing pole in a helical fashion.
3. The writing element of claim 1, wherein the conducting coil is formed of first and second coil layers respectively positioned above and below the writing pole and connected through a vertical via.
4. A read/write head including:
 - the writing element of claim 1; and

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a read element having a read sensor sandwiched between top and bottom shields.

5. A disc drive storage system including the writing element of claim 1.
6. The magnetic writing element of claim 1, including an auxiliary pole displaced from the gap region, the auxiliary pole having a pole tip that is separated from the pole tip of the writing pole by a writer gap; wherein components of magnetization vectors at the pole tips of the writing and auxiliary pole are aligned in a direction that is approximately parallel to the hard magnetic layer in response to the magnetic signals produced by the conducting coil for longitudinal recording of data in the hard magnetic layer of the disc.
7. A perpendicular magnetic writing element for recording data to a hard magnetic recording layer, which overlays a soft magnetic layer of a rotating disc, the writing element comprising:
- a writing pole having a pole tip and extending therefrom to a back gap region;
 - a conducting coil having coil segments positioned adjacent and transverse to the writing pole and proximate the pole tip, the coil segments adapted to produce magnetic signals that orient magnetization vectors at the pole tip of the writing pole in a desired direction; and
 - an insulating material between the writing pole and the coil

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segments;

wherein the magnetic signals do not conduct to the back gap region through a return pole element.

8. The writing element of claim 7, wherein the conducting coil wraps around the writing pole in a helical fashion.
9. The writing element of claim 7, wherein the conducting coil is formed of first and second coil layers respectively positioned above and below the writing pole and connected through a vertical via.
10. A read/write head including:
the writing element of claim 7; and
a read element having a read sensor sandwiched between top and bottom shields.
11. A disc drive storage system including the writing element of claim 7.
12. A longitudinal magnetic writing element for recording data to a hard magnetic recording layer of a rotating disc, the writing element comprising:
a writing pole having a pole tip at an air bearing surface (ABS)
and extending substantially perpendicularly therefrom to a back gap region;
an auxiliary pole displaced from the gap region, the auxiliary pole

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- having a pole tip at the ABS that is separated from the pole tip of the writing pole by a writer gap;
- a conducting coil having coil segments positioned adjacent and transverse to the writing pole and proximate the ABS, the coil segments adapted to produce magnetic signals which cooperate to orient components of magnetization vectors at the pole tips of the writing and auxiliary pole in a direction that is approximately parallel to the ABS; and
- an insulating material between the writing poles and the coil segments;
- wherein the writing element is free of return pole elements that form a return path through which the magnetic signals are conducted to the back gap region.
13. The writing element of claim 12, wherein the conducting coil wraps around the writing pole in a helical fashion.
14. The writing element of claim 12, wherein the conducting coil is formed of first and second coil layers respectively positioned above and below the writing pole and connected through a vertical via.
15. A disc drive storage system including the writing element of claim 12.
16. A read/write head including:
the writing element of claim 12; and

a read element adjacent the ABS and having a read sensor sandwiched between top and bottom shields.

17. A perpendicular magnetic writing element for recording data to a hard magnetic recording layer of a rotating disc, the writing element comprising:

a perpendicular writing means for writing magnetic transitions in the hard magnetic recording layer, wherein magnetic signals do not conduct to the back gap region through a return pole element.; and

a conducting coil having coil segments positioned adjacent and transverse to the perpendicular writing means, the coil segments adapted to produce magnetic signals which cooperate to orient magnetization vectors in the perpendicular writing means in a desired direction.

18. The writing element of claim 17, wherein the perpendicular writing means includes a writing pole having a pole tip and extending therefrom to the back gap region.

19. The writing element of claim 17, including an auxiliary pole displaced from the gap region, the auxiliary pole having a pole tip that is separated from the pole tip of the writing pole by a writer gap; wherein components of magnetization vectors at the pole tips of the writing and auxiliary poles are aligned in a direction that is approximately parallel to the recording layer in response to the magnetic signals produced by the

conducting coil.

20. The writing element of claim 17, wherein the conducting coil wraps around the perpendicular writing means in a helical fashion.

21. The writing element of claim 17, wherein the conducting coil is formed of first and second coil layers respectively positioned above and below the perpendicular writing means and connected through a vertical via.

22. A read/write head including:
the writing element of claim 17; and
a read element having a read sensor sandwiched between top and bottom shields.

23. A disc drive storage system including the writing element of claim 17.

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